## REMARKS

### Status Of Application

Claims 1, 3, 4, 7, 9, 10, 13, 16, 19 and 21 are pending in the application; the status of the claims is as follows:

Claims 1, 3, 7, 9, 19 and 21 are rejected under 35 U.S.C. § 103(a) as being obvious over U.S. Patent No. 5,389,943 to Brommer et al ("Brommer et al") in view of U.S. Patent No. 6,035,089 to Grann et al ("Grann et al"); and

Claims 4, 10, 13 and 16 are rejected under 35 U.S.C. § 103(a) as being obvious over Grann et al.

### 35 U.S.C. § 103(a) Rejections

The rejection of claims 1, 3, 7, 9, 19 and 21 under 35 U.S.C. § 103(a), as being unpatentable over Brommer et al in view of Grann et al, is respectfully traversed based on the following.

As currently presented, claim 1 recites, in part:

> a first medium having a thickness, the first medium defining a plurality of periodically spaced hollow portions having a depth less than the thickness of the first medium; and
>
> a second medium being dispersed within the hollow portions formed in the first medium,
>
> wherein a first layer of the device forms a photonic crystal formed partially of the first medium having a depth identical to the depth of the hollow portions, and
>
> wherein a second layer of the device is formed entirely of the first medium.

Thus, as seen above, Claim 1 requires, *inter alia*, that a first medium be defined in two layers, a first layer including and being defined by a plurality of periodically spaced hollow portions filled with a with a second medium. Thus, the hollow portions have a depth less than the thickness of the first medium so that the resulting first layer of the

device has a depth identical to the depth of the hollow portions, and the second layer of the device is formed entirely of the first medium.

In contrast, Brommer et al discloses two filters. One is a band stop filter and another is a tunable filter. Both filters have lattice structure. The lattice structure comprises a plurality of parallel elongated elements formed of a non-conductive, high-dielectric material disposed in a two-dimensional periodic arrangement within the background material made of a non-conductive, high-dielectric material (*See* col. 1, line 52 to col. 2, line 14). According to Brommer et al, the elements extend **through** the background material (col. 2, line 9-14).

That is, as acknowledged by the present office action, Brommer et al discloses that the depth of the hollow portions extends completely through the background material. Accordingly, Brommer et al fails to disclose or suggest the feature recited in claim 1 that the hollow portions have a depth less than the thickness of the first medium. Similarly, Brommer et al fails to disclose or suggest that the second layer of the device is formed entirely of the first medium.

Grann et al discloses an integrated narrowband optical filter based on embedded subwavelength resonant grating structures to form a waveguide and methods of tuning the performance of the grating structure. According to Grann et al col. 4, lines 15-32, the starting point is to use a waveguide constructed with a core, cladding, and substrate material. The desired pattern is written into a photoresist layer deposited on the top of the waveguide layer (core material). Holes are etched into the waveguide layer, and are later filled with an appropriate material to form the embedded resonant gratings or structures 310. Finally, the surface is polished to eliminate any surface irregularities caused during deposition of the appropriate material within the holes. By this process, the embedded optical filter 330 is formed in the waveguide layer 320, which is adjacent to the

substrate layer (substrate material) having a lower refractive index than the waveguide layer. (*See* col. 3, lines 62-67.)

Referring to Fig. 3 and col. 3, lines 58-61 of the specification, the key element of the integrated optical filter 330 of Grann et al is that a resonant structure 310 is embedded within a planar waveguide 320 to create an integrated narrowband optical filter 330. While the present office action states "Grann et al teach for example, the hollow portions having a depth less than the thickness of the first medium..." a careful look at Grann et al shows otherwise. Instead, like Brommer et al, Figures 3 and 4 of Grann et al illustrate that the depth or thickness of the resonant structures is **the same** as the thickness of the waveguide. That is, as can be seen by the broken line in Fig. 3, because the bottom of the rearmost of the resonant structures aligns with the broken line, it is readily apparent that the resonant structures have a **same depth** or thickness as the thickness of the waveguide.

With respect, it is believed that the examiner has applied an improper "obvious to try" rationale in applying the teachings of Grann et al. That is, in essence the present rejection is saying "what would have been 'obvious to try' would have been to vary all parameters or try each of numerous possible choices until one possibly arrived at a successful result, where the prior art gave either no indication of which parameters were critical or no direction as to which of many possible choices is likely to be successful." MPEP 2145

More specifically, Grann et al makes a general suggestion that manipulating any of the parameters of the resonant structure (angle of incidence, refractive indices, grating spacing, grating period ($\Lambda$), grating thickness (d) can result in a tuning of the output response (col. 5, line 45-49). Grann et al does not suggest varying the depth of grating nor is the grating depth indicated in equations (1), (2), (3) or (4). Thus, because Grann et al teaches that the resonant structures extend through the optical filter 330, if one skilled in the art were to look to the teaching of Grann et al to vary the depth of the resonant

structures, one skilled in the art would merely think to correspondingly vary the depth of the optical filter 330. It should be noted that the various parameters and how they are considered to apply to Grann et al is illustrated below in Fig. A. Thus, based on the above, one skilled in the art would not take from Grann et al the idea that the first medium should have a thickness and define a plurality of periodically spaced hollow portions having a depth less than the thickness of the first medium.

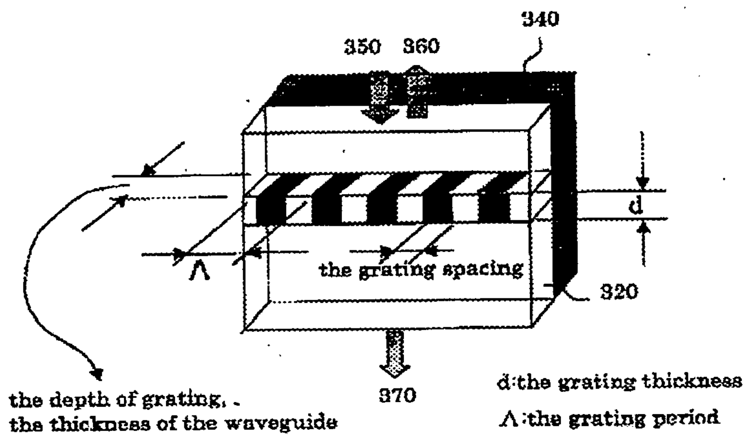


Fig. A

Additionally, while the waveguide structure of Grann, et al has separate core, cladding and substrate materials, the device of the present claim does not have separate core, cladding and substrate materials. Instead, the invention of the present claim uses a first material for the second layer (which corresponds to both the substrate and cladding layers of Grann, et al combined) and the invention of the present claim also uses this first material (in combination with a second material) for the first layer.

Finally, while Grann et al discloses that the grating thickness can be manipulated, this is taken in the context of the entire patent, which illustrates that the resonant grating

structures and the cladding material are formed to the same depth. Thus, the depth of the entire waveguide layer and not just the resonant structures would be effected.

Thus, because neither Brommer et al nor Grann et al, singly or in combination, disclose, suggest, or teach the structure of claim 1 and because the statement in Grann et al that one could "manipulat[e] any of the resonant structure's parameters" is nothing more than an "obvious to try" rationale, these references are unable to render obvious the invention of claim 1.

Claim 3 depends from claim 1 and thus distinguishes from Brommer et al and Grann et al for at least the same reasons as claim 1.

The rejection of claim 7 will be addressed next. Claim 7 as now presented, recites:

> An optical device comprising:
>
> a first medium having a thickness, the first medium at least partially forming a first layer and a second layer of the optical device, the first layer having a plurality of periodically spaced protruding portions surrounded by hollow portions having a depth less than the thickness of the first medium, the first layer having a depth identical to the depth of the hollow portions; and
>
> a second medium being dispersed within the hollow portions surrounding the plurality of periodically spaced protruding portions of the first layer,
>
> wherein the first layer is a photonic crystal, and the second layer is formed entirely of the first medium, and
>
> wherein the first layer and the second layer are integrated.

As seen above, Claim 7 requires, *inter alia*, that a first medium be defined in two layers, a first layer including and being defined by a plurality of periodically spaced protruding portions surrounded hollow portions filled with a second medium. The hollow portions have a depth less than the thickness of the first medium so that the resulting first layer of the device has a depth identical to the depth of the hollow portions, and the second layer of the device is formed entirely of the first medium.

As discussed above, neither Brommer et al nor Grann et al explicitly or implicitly disclose, suggest, or teach such a structure where the hollow portions have a depth less than the thickness of the first medium and the first layer has a depth identical to the depth of the hollow portions. Brommer et al discloses that the depth of the hollow portions extends completely through the background material. Similarly, like Brommer et al, Grann et al shows that that the depth or thickness of the resonant structures is **the same** as the thickness of the waveguide (as illustrated in Figures 3 and 4). Also, while Grann et al makes a general suggestion that manipulating any of the parameters of the resonant structure (angle of incidence, refractive indices, grating spacing, grating period ($\Lambda$), grating thickness (d) can result in a tuning of the output response (col. 5, line 45-49). Grann et al does not suggest varying the depth of grating nor is the grating depth indicated in equations (1), (2), (3) or (4).

The office action also acknowledges that Grann et al "fail to implicitly teach the first medium having a depth identical to the depth of the hollow portions" but again turns to the statement in Grann et al that one could "manipulat[e] any of the resonant structure's parameters" as a suggestion to arrive at the present invention. As discussed above, the quoted statement from Grann et al is nothing more than an invitation to experiment without any indication of which parameters are critical and no direction as to which of many possible choices is likely to be successful. Such a statement is insufficient to suggest the limitations of claim 7 starting from the inadequate disclosure of Grann et al.

Thus, because neither Brommer et al nor Grann et al, singly or in combination, disclose, suggest, or teach the structure of claim 7 and because the statement in Grann et al that one could "manipulat[e] any of the resonant structure's parameters" is nothing more than an "obvious to try" rationale, these references are unable to render obvious the invention of claim 7.

Claim 9 depends from claim 7 and thus distinguishes from Brommer et al and Grann et al for at least the same reasons as claim 7.

The rejection of claim 19 will be addressed next. Claim 19 as now presented recites:

> An optical device comprising:
> a first medium having a thickness, the first medium at least partially forming an integrated first layer and second layer of the optical device, the first layer defining a plurality of periodically spaced hollow portions, the hollow portions having a depth less than the thickness of the first medium, the first layer having a depth identical to the depth of the hollow portions; and
> a second medium being dispersed within the hollow portions,
> wherein the first layer of the optical device forms a photonic crystal, and
> wherein the second layer of the device is formed at least partially of the first medium.

As seen above, Claim 19 requires, *inter alia*, that a first medium be defined in two layers, a first layer including and being defined by a plurality of periodically spaced hollow portions filled with a second medium. The hollow portions have a depth less than the thickness of the first medium so that the resulting first layer of the device has a depth identical to the depth of the hollow portions.

As discussed above, neither Brommer et al nor Grann et al explicitly or implicitly disclose, suggest, or teach such a structure where the hollow portions have a depth less than the thickness of the first medium and the first layer has a depth identical to the depth of the hollow portions. Brommer et al discloses that the depth of the hollow portions extends completely through the background material. Similarly, like Brommer et al, Grann et al shows that the depth or thickness of the resonant structures is **the same** as the thickness of the waveguide (as illustrated in Figures 3 and 4). Also, while Grann et al makes a general suggestion that manipulating any of the parameters of the resonant structure (angle of incidence, refractive indices, grating spacing, grating period ($\Lambda$),

grating thickness (d) can result in a tuning of the output response (col. 5, line 45-49). Grann et al does not suggest varying the depth of grating nor is the grating depth indicated in equations (1), (2), (3) or (4).

The office action also acknowledges that Grann et al "fail to implicitly teach the first medium having a depth identical to the depth of the hollow portions" but again turns to the statement in Grann et al that one could "manipulat[e] any of the resonant structure's parameters" as a suggestion to arrive at the present invention. As discussed above, the quoted statement from Grann et al is nothing more than an invitation to experiment without any indication of which parameters are critical and no direction as to which of many possible choices is likely to be successful. Such a statement is insufficient to suggest the limitations of claim 19 starting from the inadequate disclosure of Grann et al.

Thus, because neither Brommer et al nor Grann et al, singly or in combination, disclose, suggest, or teach the structure of claim 19 and because the statement in Grann et al that one could "manipulat[e] any of the resonant structure's parameters" is nothing more than an "obvious to try" rationale, these references are unable to render obvious the invention of claim 19.

Claim 21 depends from claim 19 and thus distinguishes from Brommer et al and Grann et al for at least the same reasons as claim 21.

Accordingly, it is respectfully requested that the rejection of claims 1, 3, 7, 9, 19 and 21 under 35 U.S.C. § 103(a) as being unpatentable over Brommer et al in view of Grann et al, be reconsidered and withdrawn.

The rejection of claims 4, 10, 13 and 16 under 35 U.S.C. § 103(a), as being obvious over Grann et al, is respectfully traversed based on the following.

Claim 4 recites:

> A method of manufacturing an optical device having a first layer functioning as an optical waveguide layer and a second layer functioning as a base layer, the method comprising the steps of:
>
> providing a resist layer on a surface of a first medium;
>
> removing portions of the resist layer to form vacancies;
>
> removing portions of the first medium corresponding to the vacancies to create cavities in the first medium, the depth of the cavities being less than a thickness of the first medium, and thereby defining the first layer and second layer;
>
> removing the resist layer completely;
>
> filling the cavities in the first medium with a second medium, thereby forming the optical waveguide layer; and
>
> removing any excess film of the second medium from the surface of the first medium,
>
> wherein the index of refraction of the second medium is greater than the index of refraction of the first medium.

As seen above, claim 4 requires, *inter alia*, that a first medium be processed to create vacancies therein having a depth less than the thickness of the first medium and these vacancies be filled with a second medium having a higher refractive index. More generally, claim 4 requires that the waveguide of the claimed invention be created by forming the vacancies in the first medium and then filling these vacancies.

Grann et al discloses an integrated narrowband optical filter based on embedded subwavelength resonant grating structures to form a waveguide and methods of tuning the performance of the grating structure. According to Grann et al col. 4, lines 15-32, the starting point is to use a waveguide constructed with a core, cladding, and substrate material. The desired pattern is written into a photoresist layer deposited on the top of the waveguide layer (core material). Holes are etched into the waveguide layer, and are later filled with an appropriate material to form the embedded resonant gratings or structures 310. Finally, the surface is polished to eliminate any surface irregularities caused during deposition of the appropriate material within the holes. By this process, the embedded optical filter 330 is formed in the waveguide layer 320, which is adjacent to the substrate

layer (substrate material) having a lower refractive index than the waveguide layer. (*See* col. 3, lines 62-67.)

Referring to Fig. 3 and col. 3, lines 58-61 of the specification, the key element of the integrated optical filter 330 of Grann et al is that a resonant structure 310 is embedded within a planar waveguide 320 (numbered but not illustrated) to create an integrated narrowband optical filter 330.

In contrast to the invention of claim 4, as noted above, Grann et al teaches that the depth or thickness of the resonant structures is **the same** as the thickness of the waveguide. Nowhere in Grann et al is there a suggestion to form a structure such that the first medium should have a thickness and define a plurality of periodically spaced hollow portions having a depth less than the thickness of the first medium. This reason alone is sufficient to distinguish claim 4 from Grann et al.

However, also in contrast to the invention of claim 4, Grann et al discloses a process whereby first an optical waveguide is created with component core, cladding and substrate layers and materials. Only after the waveguide is created is the waveguide processed by photolithographic methods and reactive ion etching to form holes within the waveguide which are eventually filled with a second material to form the subwavelength resonant structure.

The invention of claim 4, in distinction, forms the waveguide itself only after the cavities in the first medium are filled with the second medium. In other words, Grann et al etches a waveguide to form holes to form a resonant structure, the invention of claim 4 forms holes in a first medium to form a waveguide. Thus, the process of claim 4 and that of Grann et al are utterly different.

Claim 10 as presently presented recites:

> A method of manufacturing an optical device having a first layer functioning as an optical waveguide layer and a second layer functioning as a base layer, the method comprising the steps of:
> providing a resist layer on a surface of a first medium;
> removing portions of the resist layer to form vacancies;
> removing portions of the first medium corresponding to the vacancies to create cavities in the first medium, the depth of the cavities being less than a thickness of the first medium, and thereby defining the first layer and second layer;
> filling the cavities in the first medium with a second medium, thereby forming the optical waveguide layer; and
> removing the resist layer and any excess film of the second medium from the surface of the first medium,
> wherein the index of refraction of the second medium is greater than the index of refraction of the first medium.

As seen above, claim 10 requires, *inter alia*, that a first medium be processed to create vacancies therein having a depth less than the thickness of the first medium and these vacancies be filled with a second medium having a higher refractive index. More generally, claim 10 requires that the waveguide of the claimed invention be created by forming the vacancies in the first medium and then filling these vacancies.

In contrast to the invention of claim 10, as noted above, Grann et al teaches that the depth or thickness of the resonant structures is **the same** as the thickness of the waveguide. Nowhere in Grann et al is there a suggestion to form a structure such that the first medium should have a thickness and define a plurality of periodically spaced hollow portions having a depth less than the thickness of the first medium. This reason alone is sufficient to distinguish claim 10 from Grann et al.

However, also in contrast to the invention of claim 10, Grann et al discloses a process whereby first an optical waveguide is created with component core, cladding and substrate layers and materials. Significantly, only after the waveguide is created is the waveguide processed by photolithography methods and reactive ion etching to form holes

within the waveguide which are eventually filled with a second material to form the subwavelength resonant structure.

The invention of claim 10, in distinction, forms the waveguide itself only after the cavities in the first medium are filled with the second medium. In other words, Grann et al etches a waveguide to form holes to form a resonant structure, the invention of claim 10 forms holes in a first medium to form a waveguide.

Thus, for at least the reasons stated above, the process of claim 10 and that of Grann et al are utterly different.

Claim 13 recites:

> An optical device having a first layer functioning as an optical waveguide layer and a second layer functioning as a base layer, formed by a method comprising the steps of:
> providing a resist layer on a surface of a first medium;
> removing portions of the resist layer to form vacancies;
> removing portions of the first medium corresponding to the vacancies to create cavities in the first medium, the depth of the cavities being less than a thickness of the first medium, and thereby defining the first layer and second layer;
> removing the resist layer completely;
> filling the cavities in the first medium with a second medium, thereby forming the optical waveguide layer; and
> removing any excess film of the second medium from the surface of the first medium,
> wherein the index of refraction of the second medium is greater than the index of refraction of the first medium.

Thus, claim 13 defines the claimed invention as a product in terms of the process by which it is made. While what is claimed is a product, attributes of the product are plainly implied as a result of the claimed process by which it is made. MPEP 2113

As seen above, claim 13 requires, *inter alia*, that a first medium be processed to create vacancies therein having a depth less than the thickness of the first medium and these vacancies be filled with a second medium having a higher refractive index.

In contrast to the invention of claim 13, as noted above, Grann et al teaches that the depth or thickness of the resonant structures is **the same** as the thickness of the waveguide. Nowhere in Grann et al is there a suggestion to form a structure such that the first medium should have a thickness and define a plurality of periodically spaced hollow portions having a depth less than the thickness of the first medium. This reason alone is sufficient to distinguish claim 13 from Grann et al.

Claim 16 as presently presented recites:

> An optical device having a first layer functioning as an optical waveguide layer and a second layer functioning as a base layer, formed by a method comprising the steps of:
> providing a resist layer on a surface of a first medium;
> removing portions of the resist layer to form vacancies;
> removing portions of the first medium corresponding to the vacancies to create cavities in the first medium, the depth of the cavities being less than a thickness of the first medium, and thereby defining the first layer and second layer;
> filling the cavities in the first medium with a second medium, thereby forming the optical waveguide layer; and
> removing the resist layer and any excess film of the second medium from the surface of the first medium,
> wherein the index of refraction of the second medium is greater than the index of refraction of the first medium.

Thus, claim 16 defines the claimed invention as a product in terms of the process by which it is made. While what is claimed is a product, attributes of the product are plainly implied as a result of the claimed process by which it is made.

As seen above, claim 16 requires, *inter alia*, that a first medium be processed to create vacancies therein having a depth less than the thickness of the first medium and these vacancies be filled with a second medium having a higher refractive index.

In contrast to the invention of claim 16, as noted above, Grann et al teaches that the depth or thickness of the resonant structures is **the same** as the thickness of the waveguide. Nowhere in Grann et al is there a suggestion to form a structure such that the first medium should have a thickness and define a plurality of periodically spaced hollow portions having a depth less than the thickness of the first medium. This reason alone is sufficient to distinguish claim 16 from Grann et al.

Accordingly, it is respectfully requested that the rejection of claims 4, 10, 13 and 16 under 35 U.S.C. § 103(a) as being obvious over Grann et al, be reconsidered and withdrawn.

In view of the foregoing remarks, this application is considered to be in condition for allowance and an early reconsideration and Allowance are respectfully requested.

If an extension of time is required to enable this document to be timely filed and there is no separate Petition for Extension of Time filed herewith, this document is to be construed as also constituting a Petition for Extension of Time Under 37 C.F.R. § 1.136(a) for a period of time sufficient to enable this document to be timely filed. Any other fee required for such Petition for Extension of Time and any other fee required by this document pursuant to 37 C.F.R. §§ 1.16 and 1.17, other than the issue fee, and not

submitted herewith should be charged to Sidley Austin Brown & Wood LLP's Deposit Account No. 18-1260. Any refund should be credited to the same account.

Respectfully submitted,

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